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AIRPLANE PERFORMANCE, PAST AND PRESENT.

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The recording of airplane performance had its beginning on December 17, 1903, when the Wright brothers' airplane was given its first successful trial at Kitty Hawk, N. C., and the anniversary of that historic feat offers a peculiarly favorable opportunity for the making of a survey of progress.

Some stages of the progress have been more rapid than others, but there has been less variation in the rate of advance than is sometimes supposed. There have been intervals when aviation seemed to be in the doldrums in the United States, and most of the European countries have similarly passed through periods of quiet, but the quietness has usually been induced by a temporary change of Government policy and by a failure to stand behind research and development work with that degree of governmental support which is necessary to insure the maximum rapidity of progress in the pioneering stages, and while one country was quiet others have been going ahead. Certainly there was no cessation of aeronautical development anywhere between 1914 and 1918, and since the armistice the development of flying craft has gone on quite unchecked, alike for the purposes of commerce and of war.

It is usual to express the performance of a particular airplane, or to define the status of the art of airplane design at a given time, by citation of the records for speed, for altitude

* Taken from the Christian Science Monitor, December 19, 1922.

and for distance of duration without stop. A study of the subject of this article may perhaps best be made by tracing the advance of those three records in turn and by examining briefly into the means by which the various improvements in the records have been made.

Speed may be chosen for first place in the discussion, for there is no feature of flight which takes a more forcible hold on the imagination than does the sheer velocity attained. It is only a few years, however, since the speeds made were very moderate even by racing automobile and locomotive standards. Only since the war has the maximum speed in the air surpassed that of the fastest earthbound vehicle, but there is no rival for the airplane now.

The speed of the early Wright biplanes was about 30 miles an hour, and it was several years after the first flight before there was material advance over that figure. The first international airplane race was held in August, 1909, and was won by Glenn H. Curtiss, founder of the company which this year built the Curtiss army racer for the Detroit competitions, on a biplane of his own design and at an average speed of 47 miles an hour. The mile-a-minute figure was reached the next year, and from that time the advance was rapid, as the real importance of "streamlining" to reduce resistance began to be realized. Ninety miles an hour was attained in 1911, two miles a minute in 1913. During the war there was little increase in absolute maximum speeds, but high speed was combined with controllability and easy landing,

so that what had once been hazardous even for experienced racing pilots became commonplace for beginners. At the present time the airplanes used for the first stages of training are capable of speeds higher than the maximum that could be attained by the winner of the Gordon Bennett race, then representative of the international speed championship, a dozen years ago.

The war over, engineers and pilots turned their attention once more to racing. Profiting by the availability of a vast accumulation of data from Government laboratories for the improvement of their designs, they were able to step the speed up immediately to the neighborhood of three miles a minute. The record has changed hands nearly a score of times in three years, usually pushed ahead a mile or so at a time, usually held by a French machine. Two hundred miles an hour was reached about a year ago, and 211 was the mark which stood on the books this fall up to the time when the Curtiss army racer was brought forth at Detroit. The story of the performances there, when the official record was pushed up to 225 miles an hour, the largest single advance that had been made in three years, is too well known to need repetition. Let it suffice to note, as a single measure of the scale of progress, that the maximum speed recorded as having been made by an airplane is now 4 1/2 times as great as it was at the time of the Rheims meet of 1909.

Limitations of space forbid any technical analysis of the means by which increased speeds have been secured. In summary, however, they may be attributed to increased attention to detail

in design and to the increased utilization of the results of research. Constant "cleaning up" of the structure, elimination of the exposed parts which offered resistance and which were not necessary to the strength of the airplane, has brought its reward, as has the study in the aeronautical laboratory of the relative merits of wings and bodies of various forms and the immediate application of laboratory results to design. The power plant has also been of great importance, an importance suggested by the increase in the power used on single-passenger racing airplanes. The first airplane flown by the Wrights had only 12 horsepower. Curtiss used 60 in 1909. The winner in 1912 had 160 horsepower in his airplane, and from 350 to 600 is now the usual rule.

In respect of the second of the three major records, that for altitude, the advance has been even more spectacular. No altitude instruments were carried in the Wrights' first flight, nor in any flight for a long time thereafter, but it was the practice in those early years to fly only 10 or 15 feet high, or even closer to the ground at times. The pilots stayed close to their landing fields and they saw no reason to get far above the earth. Altitude records finally began to be kept, however, and at the Rheims meet of 1909, the same one where Curtiss won the first Gordon Bennett race, Latham startled the world by climbing to an altitude of 490 feet. No pilot would now think of starting on even the most modest cross-country trip over the best of country at so modest a height. Within another year 6000 feet was

reached, and 10,000 had been passed before the beginning of 1911. That was doubled again before the war, and after the armistice the record was soon raised to 30,000. Further increases had to wait for the coming of the supercharger. With that accessory, which holds the engine power constant at all altitudes, 40,000 feet, more than 7 1/2 miles, has been attained. The ratio of increase in maximum altitude in 13 years is almost fantastic, the present record, held by Lieutenant MacReady, being more than 80 times as high as that established at the first Rheims meet.

Aside from the effect of the supercharger, already mentioned, increasing the altitude has been largely a matter of cutting down weight and increasing power. Aerodynamic efficiency and the reduction of structural resistance have some influence, to be sure, but altitude is primarily a matter of the weight carried per square foot of wing surface and per horsepower, and the lighter the engine used and the higher its power, the better are the chances of making a record.

The third record deals with the length of time that an airplane can stay off the ground, and it is governed chiefly by structural efficiency, or by the ratio of weight of the empty airplane to the maximum total weight that can be supported in flight, and by the efficiency and economy of the power plant. For the beginning of duration development we may turn all the way back to 1903, to that December day when practical flying was born. The longest flight then lasted only 59 seconds and covered a little less than 300 yards against a head wind. Five years

later Wilbur Wright visited France and astounded the Europeans, previously skeptical of his reported achievements, by making a flight lasting two hours and 30 minutes. The next summer, again at that Rheims meet where so many records were broken and which constituted the first effective large-scale demonstration of the reality aerial travel, Farman stayed aloft for four hours continuously, and during the next year the same pilot raised the time to eight hours.

Further advances were made at intervals in the next three years, and just before the beginning of the war a German pilot came within a few minutes of the 24-hour mark. The improvement since the termination of hostilities had been slow, and increases of the record had been infrequent, until this summer, when Lieutenants MacReady and Kelly suddenly jumped the time up nearly 50 per cent, flying for more than 35 hours without landing. Only a few days later two French pilots made a record about an hour shorter than that of the American officers. In the early days duration records were made on airplanes of relatively small size and carrying the pilot alone, but the flights are now so long that they have outpaced the physical powers of a single man and it is necessary to use a larger airplane and provide for a relief pilot. The airplane in which Farmen made his record of 1910 had a 50-horsepower engine and weighed about 1800 pounds loaded ready for flight, but that of MacReady and Kelly carried 400-horsepower and weighed just over five tons.

History is useful largely in guiding us to an intelligent

anticipation of the future, and the study of the past records of airplane performance should enable us to foresee something of the probable development of the next few years. Attempts at prophecy, however, will be withheld for another article.